AN AERIAL SURVEY OF MUSKOXEN IN THE PAULATUK AREA OF THE INUVIALUIT SETTLEMENT REGION, MARCH 1997

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AN AERIAL SURVEY OF MUSKOXEN IN THE PAULATUK AREA OF THE INUVIALUIT SETTLEMENT REGION, MARCH 1997

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ABSTRACT

A strip transect survey was conducted on March 10, 11, 12, 18, and 19, 1997 in an area bounded by the Amundsen Gulf to the north, the Inuvialuit Settlement Region Boundary (68° N latitude) to the south, the 127° 45' W longitude to the west, and portions of the Brock, Hornaday and Horton Rivers to the east. Forty-four groups of muskoxen were observed, 253 adults and 33 calves on transect and 133 adults and 10 calves off transect. The estimate of non-calf muskoxen was 2567 $\pm$ 724 (SE of the estimate), density estimate 0.07/km^2. Percent calves of the surveyed population (on transect) was 11.5%. The population estimate is not significantly different from those determined from previous surveys of similar area conducted in the 1980's. Winter distribution of animals was different from that in the 1980's. Few animals were located in areas considered to be high density in 1980 and 1983. Few animals were seen the barren lands to the north and east of the survey area. The majority of the animals were found below treeline to the southwest, or associated with the river breaks along the Horton, West, and Anderson Rivers. Maximum harvest levels from 1991 to 1995 represent 1.5% of the current population estimate.

TABLE OF CONTENTS

ABSTRACT ii

LIST OF TABLES iv

LIST OF FIGURES v

INTRODUCTION 1

METHODS 3

RESULTS 5

DISCUSSION 6

RECOMMENDATIONS 12

ACKNOWLEDGEMENTS 13

PERSONAL COMMUNICATIONS 14

LITERATURE CITED 15

APPENDIX 1 21

APPENDIX 2 22

APPENDIX 3 27

LIST OF TABLES

Table 1. Muskox population estimates (SE) from this previous surveys in the west central arctic.

LIST OF FIGURES

Figure 1. The study area.

Figure 2. The study area, the area surveyed in 1987 (depicted by the vertical hash marks) and the area surveyed in 1997 (depicted by both the vertical and diagonal hash marks).

Figure 3. The location of groups of muskoxen observed on the 1997 survey (on and off transect).

1

INTRODUCTION

There have been a limited number of surveys specifically for muskoxen in the west central arctic, north of Great Bear Lake to the Beaufort Sea coast (Spencer, 1976; 1980; Case and Poole, 1985, McLean, 1992), with the last survey conducted in summer 1987 (McLean, 1992). Recently, there has been an increased local interest in muskox population dynamics. With an increase in successful sport hunts for muskoxen in Paulatuk (C. Baetz, pers. comm.; Fabijan, unpubl. data), concerns have been raised that population levels were able to sustain harvest quotas. During community consultations for the Bluenose Caribou Management Plan the lack of a more current estimate of the muskox population was a major topic (J. Nagy, pers. comm.). The evidence of diet similarity between muskoxen and Peary caribou on Banks Island (Larter and Nagy, 1997), has also created concern in local communities that muskoxen and barren-ground caribou on the mainland may compete for food and if muskox populations increase caribou may suffer.

Indices of both productivity and overwinter survival of circumpolar muskox populations are relatively similar (N. Larter and J. Nagy, unpubl. data). Muskox numbers steadily rose on Banks Island from 1972 to 1994 (Nagy *et al.*, 1996), but decreased between 1994 and 1998 (J. Nagy and M. Branigan, unpubl. data). Muskox range has been expanding eastward from Alaska into the Yukon and western Northwest Territories with more frequent sightings around Aklavik and along the Dempster highway (Reynolds, 1998; N. Larter, unpubl. data; P. Reynolds, pers. comm.), thus implying an increasing population. Whether or not muskox numbers in the west central arctic have increased since the last estimate in 1987 is unknown.

This survey was conducted in response to: 1) concerns from people in Paulatuk regarding

sustainable harvest and changes in harvesting quota, 2) a mandate from the Bluenose Caribou Management Plan, and 3) as part of a long term population monitoring program of the Department of Resources, Wildlife & Economic Development. In order to address issues related to harvest quotas and to muskoxen and caribou interactions data on the distribution and numbers of animals are critical. This report documents the number and distribution of muskoxen found in the west central arctic within the Inuvialuit Settlement Region (ISR) (north of the 68° N latitude) during late winter, 1997, and compares the results with previous surveys in the area. A similar survey was conducted in the Sahtu Region south of the ISR boundary to Great Bear Lake during March, 1997. The results of that survey will be reported elsewhere (Veitch, 1997).

METHODS

Study Area

The study area totals 42,454 km^2 and was bounded by the Amundsen Gulf to the north, the Inuvialuit Settlement Region Boundary (68° N latitude) to the south, and the 127° 45' W longitude to the west. The eastern boundary incorporates portions of the Brock and Hornaday Rivers in the north and the Horton River in the south (Figures 1 and 2). The survey area excludes the frozen waters of Darnely and Franklin Bays as well the offshore island in Wright Bay and Clapperton Island in Darnley Bay. The survey area used to derive population estimates totals 36,730 km^2 (Figure 2).

Survey Design

A strip transect survey was conducted on March 10, 11, 12, 18, and 19, 1997. Twenty-two transects, spaced 10 km apart (10% coverage) were flown in an east-west direction at approximately 160 km/hr over the study area. Start and end points of the transects were entered into an on board global positioning system (gps) to assist in navigation. The survey transect width was 0.5 km on each side of the Cessna 185 aircraft. Tape markers were placed on the rear windows to designate the outside transect boundary given a survey altitude of 200 m above ground level (agl) (following Norton-Griffiths, 1978). The markers were checked against a known distance on the Paulatuk runway. After completing the southern part of the survey area (10-12 March), muskoxen presence was evident along the western boundary and it was believed that muskoxen were being missed because they were distributed further west of the boundary used by McLean (1992) (W. Hagen, pers. comm.). Prior to completing the survey on 18-19 March, transect lines 13-22 were extended west

to the 127° 45' longitude, the same western boundary used for transects 1-12, adding 6,765 km^2 more survey area than had been used in 1987 by McLean (1992) (Figure 2).

The survey crew consisted of 2 observers in the rear seats, a pilot, and a recorder/observer in the front passenger seat. Part way through the survey we were without the right rear observer, so the observations were taken by the recorder. The front window was marked with tape to designate the outside transect boundary accordingly. Transect direction was chosen to minimize ferry time given the wind conditions encountered in different parts of the study area.

Observations of all wildlife, including adult and calf muskoxen were plotted on map sheets by the recorder/observer. Calf muskoxen were determined by their relative size and lack of light-coloured pelage on the back (Olesen and Thing, 1989). Locations of observations, as determined by an on board gps were also recorded.

The population estimate, population variance, and coefficient of variation were calculated using Jolly's (1969) method for unequal sized sampling units (Norton-Griffiths, 1978). The study area was digitized to determine the survey area (km^2) and the data incorporated into a GIS system. Previous survey areas (Case and Poole, 1985; McLean, 1992) were also digitized to determine survey data. Population estimates were derived for previous areas surveyed using survey data from this study. Population estimates and animal distribution were compared between surveys.

RESULTS

The survey was interrupted by a major storm from March 13-17, but was completed in 5 days. Total flying time was 42.6 hours which included return ferry time to Paulatuk from Inuvik twice (Appendix 1). The second ferry provided an opportunity to cache fuel on Tadenet Lake. Limited visibility forced us to abandon one transect prior to its completion before the storm occurred. All other entire transects or transect segments over land on the Parry Peninsula or east of Darnley Bay were completed prior to the storm (Appendix 1) i.e. there was only one transect that was not completed during a 24 hour period. Severe easterly winds on survey lines flown on 12 and 19 March prevented the aircraft from maintaining a constant speed of 160 km/hr while on transect. Speeds varied from 110-200 km/hr depending upon the direction of flight.

Forty-four groups of muskoxen were observed (Figure 3), 253 adults and 33 calves on transect and 133 adults and 10 calves off transect (Appendix 2). Total transect area was 3620.64 km^2. The resulting estimates were: 1) adult muskoxen 2567 $\pm$ 724 (SE of the estimate), coefficient of variation (CV) 0.292, 2) calf muskoxen 335 $\pm$ 107 (SE), CV 0.330, and total muskoxen 2902 $\pm$ 825 (SE), CV 0.295 (Appendix 3). Percent calves of the surveyed population (on transect) was 11.5%. The density estimate of adult muskoxen was 0.07/km^2. Other wildlife observations included: 84 adult and 4 calf caribou all on transect, 6 moose on transect, 17 wolves, 3 on transect, and 7 foxes, all on transect (Appendix 2).

DISCUSSION

Survey Conditions and Design

Case and Poole (1985) suggested that the clumped highly irregular distribution of muskoxen in winter made delineation into high and low density areas difficult and suggested surveys in summer might overcome this problem. McLean (1992) found similar clumping and irregular distribution problems during his summer survey and his results suffered from a high coefficient of variation (CV) (0.420).

High visibility of dark colored animals against a snowy background and detection of fresh tracks in winter greatly reduces visibility bias (Caughley, 1974). Therefore, given the problem of clumped distribution in previous surveys conducted during both summer and winter, a winter survey was deemed preferable. I had hoped to delineate high density areas and resurvey them at $\geq$25% coverage in order to reduce the CV of the overall estimate, but most areas of high density were associated with steep river drainages. These areas produced a number of problems for improving the population estimate. First, winds frequently associated with these drainages precluded realistically flying at a fixed altitude above ground level. This would create errors in the observation area, and the error would likely increase as coverage increased. Second, the drainages did not all run longitudinally through the proposed transect block, therefore some transects would run parallel along the river breaks and encounter many animals thus inflating the estimate. Third, in order to avoid any of the previous problems a total count of the high density areas would have been required. Removing these total count areas from the original transect data would not necessarily decrease the CV, and could potentially increase the CV.

Caughley *et al* (1976) found that speed, height above ground, transect width, and observers had significant effects on the accuracy of animal survey estimates. Survey speed was similar to previous surveys (Spencer, 1980; Case and Poole, 1985; McLean, 1992). Survey plane altitude (200 m agl) was similar to previous surveys, Case and Poole (1985) 150-300 m agl and McLean (1992) 200 m agl, but greater than Spencer (1980) 110 m agl. Transect widths (500 m a side) were similar to Spencer (1980) 400 m a side, but narrower than Case and Poole (1985) 750-1500 m a side and McLean (1992) 750 m a side. Observers for all surveys were different but consistent within each survey. I accepted the assumption that all animals seen within the transect boundaries were counted accurately. Group sizes were relatively small and on the one occasion that the observer felt unsure of the count of a group below treeline we left the transect, circled the group to recount it, and returned back to the transect. The relative accuracy of the estimates from winter surveys should be comparable, unfortunately the area surveyed in 1983 is far greater than that surveyed in 1980 and 1997. The summer survey may suffer from reduced visibility of animals caused by dark colored animals on a background of late summer vegetation and forage color and large transect widths. Therefore, numbers may be somewhat underestimated. Regardless, the distribution of animals from all surveys should be comparable.

Even though the survey was interrupted because of a severe winter storm, movement of muskoxen among areas likely did not effect the survey estimates. Muskoxen in winter rarely move more than a few kilometres a day and during severe winter storms tend to remain in very localized areas until the weather improves (Jingfors, 1982; Schaeffer and Messier, 1996; N. Larter, pers. obs.).

Observer fatigue and length of survey represent potential biases of the survey estimate. Given the dynamics of late-winter weather along the arctic coast and increasing daylength, surveys

are often conducted in such a way that flying is done whenever conditions permit and the sooner the survey flying is completed the better. During this survey, flights along transect never exceeded 4.5 hours before the plane landed so that the pilot and observers could have a break, and there was no more than 8 hours of flying along transect on any given day. Caughley *et al.* (1976) found these biases to be less important in the accuracy of the survey estimates and I believe that they had little effect on the survey results.

Population Characteristics

The population estimate of 2567 ± 724(SE) non-calf muskoxen for this area is similar to previous estimates (Table 1). The calf percentage of 11.5% is greater than the 9% reported by McLean (1992), but comparable to the 10.5% reported in Case and Poole (1985). Muskox calving occurs in April, therefore the percent calves reported by Case and Poole (1985) and in this study likely represent an index of recruits and is comparable to percent yearling data from elsewhere, whereas the percent calves reported by McLean (1992) represents an index of productivity (less neonatal and summer mortality) and is comparable to percent calf data collected during summer from elsewhere. Surveys of muskoxen on Banks Island from 1985-1996 show percent yearlings ranging from 2.9-15.9, and that percentages in summers following severe winters were lower while higher percentages follow relatively mild winters (N. Larter and J. Nagy, unpubl. data). The results of this study and of Case and Poole (1985) fall into the upper bound of this range. Calf percentages range from 8.1-28.3% (Banks Island 1985-1996)(N. Larter and J. Nagy, unpubl. data), 8.5-14.3% (Thelon Game Sanctuary)(Tener, 1965), and from 14.7-17.3% in the Queen Maud Gulf area (Spencer, 1976). McLean's (1992) value of 9% falls within the lower bound of ranges reported

elsewhere.

The distribution of animals in March 1997 is somewhat different from that found during March surveys conducted in 1980 and 1983. Animals were more evenly distributed over the study area in 1980 (Spencer, 1980) than in either 1983 or 1997. Both surveys in the 1980's found a relatively higher density of muskoxen above the treeline in the vicinity of the Brock and Hornaday Rivers and adjacent to the treeline in the Fallaize, Delesse, Granet Lakes area. The survey in 1983 treated these areas as high density strata and estimated over 300 animals in the total 4354 km^2 area. In 1997 these areas had very few muskoxen in them: two groups totalling 7 and 40 animals respectively. More animals were found in 1997 below the treeline further to the southwest and especially along the river valleys associated with the Horton, West, and Anderson Rivers (Figure 3). There were still a few scattered groups of muskoxen along the Parry Peninsula, the ocean facing slopes of the Smoking Hills and along the windswept river breaks along the Horton River above the treeline (Figure 3). The area around Horton Lake was considered a high density area also during the 2 surveys in the 1980's. A survey of that area in 1997 found very few muskoxen (Veitch, 1997).

Given the number of muskoxen estimated in the Sahtu Settlement Area (directly south of the ISR boundary to Great Bear Lake) of 1,457 $\pm$ 448 (SE) non-calves (Veitch, 1997), and the distribution of animals north of the ISR boundary, it appears that the muskox distribution in March 1997 is centered more to the southwest and below treeline than that found during the two March surveys of the 1980's. Whether this is a short term shift based upon differing annual winter snow conditions or a long term shift related to winter forage distribution, foraging energetics, or predation is unknown. People in Paulatuk believe that there is an annual movement of muskoxen into the trees for the winter (N. Green, pers. comm.). Muskoxen are more common above treeline and in the

Pearce Point areas during summer (W. Hagen, pers. comm.).

Harvest and Quotas

Two muskox harvest areas are found in the area surveyed, MX I/05 which is used by hunters from Tuktoyaktuk and MX I/06 which is used by hunters from Paulatuk. The quota for these areas is 25 animals and 50 animals, respectively. For MX I/06 the 50 animals harvested are to a maximum of 30 males and 20 females. The annual harvest of muskoxen by Tuktoyaktuk hunters ranged from 1-16 from 1991 to 1995 and totalled 26 animals (GNWT, unpubl.data; M. Fabijan, unpubl. data). Paulatuk hunters harvested 95 animals during this period ranging from 5-37 per year. There was an approximate 50:50 of male and females harvested (GNWT, unpubl. data; M. Fabijan, unpubl. data). In 1993, 32 of the 37 animals harvested were females (M. Fabijan, unpubl. data). Except for 1993 the harvest was predominantly males. Given an estimate of 2567 (SE 724) non-calf animals for the area north of the ISR boundary, the maximum number of animals harvested by both communities during any year represents 1.6% of the estimated population (range 1.1-2.1% including SE). Even if the entire quota was taken the harvest would still only be 2.9% of the estimated population.

The population estimate for a 1439.4 km^2 area around Horton Lake in March 1980 was 1,224 animals (Spencer, 1980). The population estimate for a 6,712 km^2 area encompassing Horton, Stopover and Estabrook Lakes in March 1983 was 1,083 (Case and Poole, 1985). The population estimate for the 12,335 km^2 area flown by McLean (1992) south of the ISR boundary to Great Bear Lake in August 1987 was 145 (SE 86). The population estimate for the 55,818 km^2 area flown in March 1997 was 1,457 (SE 448) (Veitch, 1997). The southern area encompasses MX S/01 which has a quota of 11 males: 4 subsistence for Colville Lake and Deline, 2 subsistence for Fort Good

Hope, and 1 resident. On average only 1 animal per year is harvested which has no impact on muskox numbers. Given the population estimate of the southern area the harvest level is <0.07% of the population and even if the quota was met it would only be <0.75 %. Subsequent to the 1997 surveys, Veitch (1997) recommended increasing the annual quota to 27 adult muskox in the Sahtu Settlement Area, maintaining that this modest increase would not endanger the population.

The muskox population estimate north of the ISR has not changed significantly in the last 15 years. The muskox population to the south of the ISR may have increased during that period; it has definitely increased its range (Veitch, 1997; A. Veitch, pers. comm.). Therefore, the mainland muskox population of the west central arctic appears to be at worst stable and possibly increasing modestly. Summing the population, areas, and all quotas together the maximum harvest level in any one year has been 0.9% and is quite sustainable.

RECOMMENDATIONS

1) Current quotas and actual levels of harvesting are sustainable given current population estimates. If the communities in the ISR could or wanted to increase their level of harvest, quotas could probably be increased by another 25 and still be sustainable.

2) The time span between population estimates should be reduced from 10 year to 5 year intervals, especially if changes in harvest quotas occur.

3) Surveys should be conducted in late winter so that survey results are as comparable as possible especially in regard to percent calves, animal distribution and sightability.

4) The survey area should be stratified into low and high density areas. 10% coverage of low density areas is adequate. Coverage should be at least 25% in high density areas. Total counts may have to be conducted in some high density areas if conditions dictate.

5) Transect widths should not exceed 1 km, 500 m per side, because part of the survey area is below treeline.

6) Surveys of the muskox population north and south of the ISR boundary should be conducted concomitantly.

ACKNOWLEDGEMENTS

I would like to thank Willard Hagen for his piloting skills in what quite often were less than ideal flying conditions. Andrew Paul is gratefully acknowledged for the fine job he did as an observer and for all his help with a myriad of odd jobs that kept the survey running in a timely fashion. Phoebe Ruben and Ken Thomsen of the Paulatuk Hamlet provided invaluable assistance in contacting and acquiring local assistance and forwarding messages between Inuvik and Paulatuk for this project. Chris Ruben is thanked for his help on the first day of the survey. J. Nagy reviewed previous drafts of this manuscript. Funding for this project was provided by the Inuvialuit Final Agreement. N. Mair of the Remote Sensing Centre is thanked for assistance with the figures.

PERSONAL COMMUNICATIONS

Conrad Baetz, Renewable Resources Officer III, Inuvik, NT

Willard Hagen, Owner/Operator BeauDel Air, Inuvik, NT

Noel Green, President Paulatuk Hunters' and Trappers' Committee, Paulatuk, NT

John Nagy, Supervisor Wildlife Management, D.R.W.E.D., Inuvik, NT

Pat Reynolds, Biologist, U.S. Fish & Wildlife Service, Fairbanks, AK

Alasdair Veitch, Biologist, D.R.W.E.D., Norman Wells, NT

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Table 1. Muskox population estimates (SE) from this and previous surveys in the west central arctic.

Estimate (SE)	Area Surveyed	Reference
2567 (724)	36,730 km^2	This study
3040 (1296)	42,300 km^2	McLean (1992)
1987 (550)	29,965 km^2	This study same area flown by McLean (1992) north of the ISR boundary.
3204 (1196)	29,965 km^2	McLean (1992) data from area north of the ISR boundary.
3391 (854)	16,546 km^2	Spencer (1980), similar area[1] to this study
3315 (634)	109,293 km^2	Case and Poole (1985) entire survey.
2020 (569)	101,534 km^2	Case and Poole (1985) less Rae-Richardson strata.

[1] Estimates based upon Spencer's A, B, C strata with A (Parry Peninsula) treated as total count.

Figure 1. The study area.

Figure 2. The study area, the area surveyed in 1987 (depicted by the vertical hash marks) and the area surveyed in 1997 (depicted by both the vertical and diagonal hash marks).

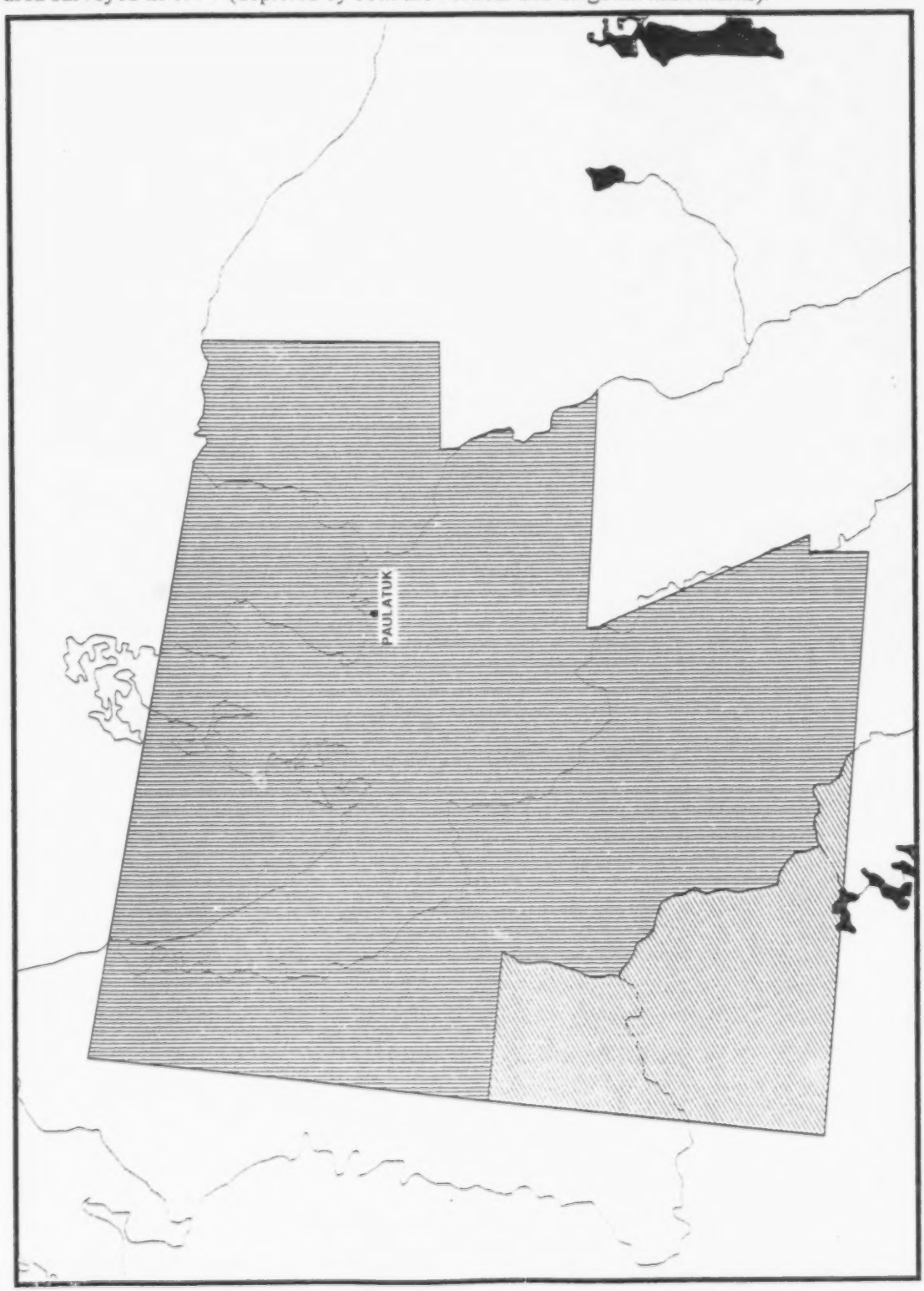
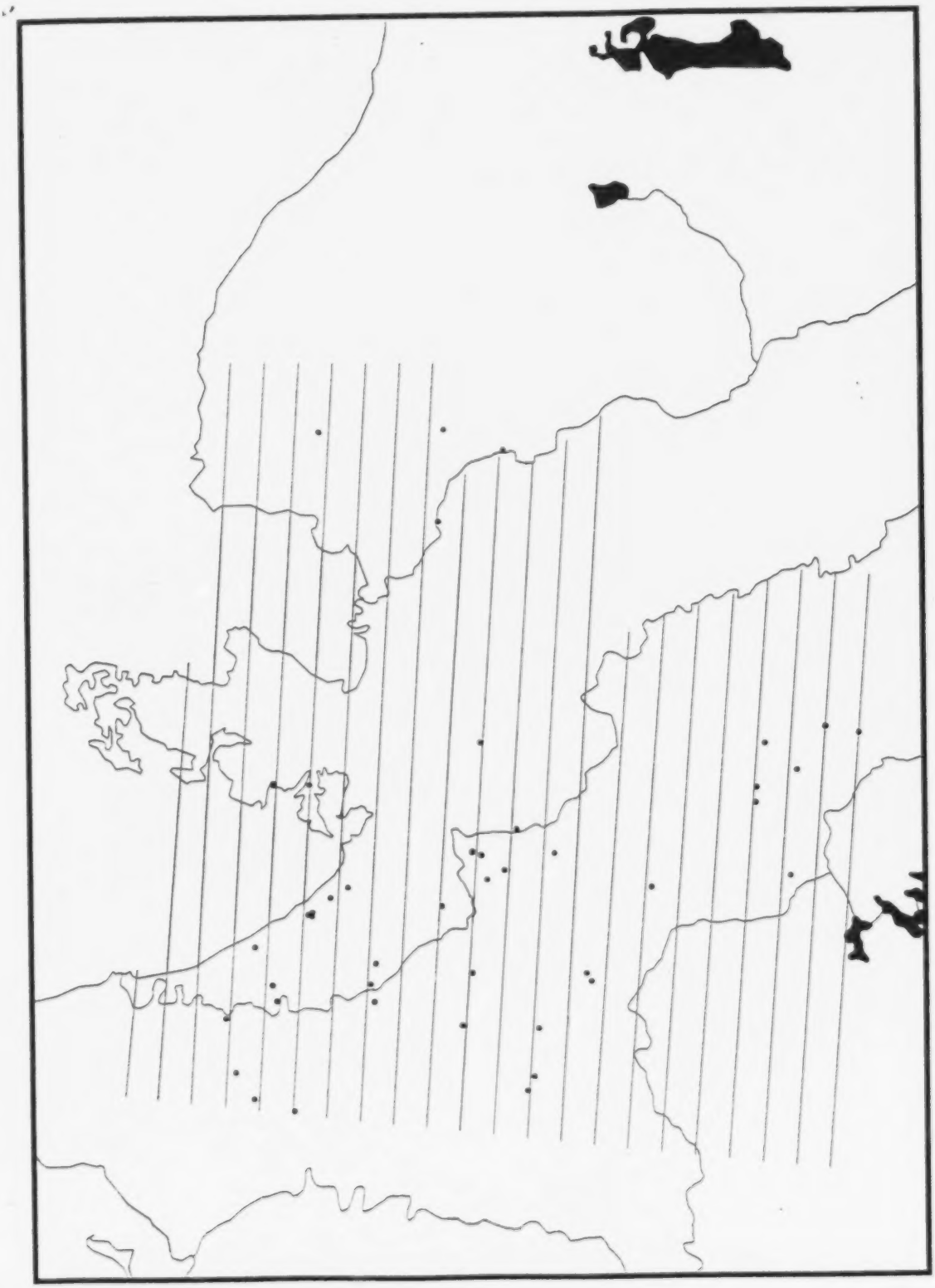


Figure 3. The location of groups of muskoxen observed on the 1997 survey (on and off transect).



APPENDIX 1

Muskox survey schedule based out of Paulatuk, March 1997.

Date	Location	Paulatuk Weather	Hours Flown	Transects Flown
10 March	Inuvik-Paulatuk-Tsoko Lk. area	Clear, winds 0-15 km/hr W, 25 km visibility, -26° to -32° C	7.2[1]	22, 21, 20, 19, 18
11 March	Perry Peninsula-Paulatuk South	High Overcast, winds 15-25 km/hr W, 13-25 km visibility, -23° to -26° C	9.5[2]	2"[3], 3", 4", 5", 6", 7", 7'A[4], 8, 17, 16, 15, 14
12 March	Pearce Pt./Melville Hills-Paulatuk South-Inuvik	Clear, winds 25-45 km/hr S and rising, 25-8 km visibility and falling, -24° to -20° C and rising	8.4[5]	3"'[6], 4"', 5"', 6"', 7"', 13, 12, 11
18 March	Inuvik-Paulatuk-Smoking Hills-Paulatuk South	Clear, calm, 25 km visibility, -26° C	8.8[7]	1, 2'[8], 3', 4', 5', 6', 7'B, 9, 10A[9]
19 March	SW Tadenet Lk. area-Paulatuk South-Inuvik	Clear to 75% Cirrus, 0-15 km/hr E, visibility 15-25 km, -20° to -32° C	8.7[10] 42.6[12]	22', 21', 20', 19', 18', 17', 16', 15', 14', 13', 10B

[1] Includes 1.9 hours ferry time Inuvik to Paulatuk.
[2] Includes 1 hour flight toward mouth of Horton River where winds prevented flying over the Smoking Hills.
[3] Transects followed by " are those parts of the transect that are flown over land on the Perry Peninsula.
[4] A 13.75 km segment of this transect crossing the Horton River was not surveyed due to poor visibility. Segment surveyed on 18th.
[5] Includes 1.7 hours ferry time transect 11 to Inuvik.
[6] Transects followed by "' are those parts of the transects flown over land to the east of Darnley Bay.
[7] Includes 2.7 hours ferry and fuel cache time from Inuvik to Paulatuk.
[8] Transects followed by ' are those parts of the transects flown over land to the west of Franklin Bay.
[9] 105.5 km of the transect was flown before dark. Remaining 89km was flown the following day.
[10] Includes 1.7 hours ferry time transect 10 to Inuvik.
[12] Includes a total of 8.0 hours ferry time to and from Inuvik.

APPENDIX 2

All observed wildlife during survey for muskoxen in the Paulatuk area, March 1997.

Obs. #	Date	Transect #	On Transect	Plane Side	Adult Muskox	Calf Muskox	Adult Caribou	Calf Caribou	Moose	Wolves	Foxes
1	Mar. 10	22	Y	R	1						
2	Mar. 10	21	Y	L	1						
3	Mar. 10	20	Y	R					1		
4	Mar. 10	20	Y	L	2						
5	Mar. 10	20	Y	L	1						
6	Mar. 10	19	Y	L	4	1					
7	Mar. 10	19	Y	L	23	4					
8	Mar. 10	19	Y	R	9						
9	Mar. 10	18	Y	R					2		
10	Mar. 11	6"	N	L	8						
11	Mar. 11	6"	Y	R					1		
12	Mar. 11	7"	Y	R					1		
13	Mar. 11	7'A	Y	L	2						
14	Mar. 11	8	Y	R	8						
15	Mar. 11	8	Y	L	4	2					

APPENDIX 2 cont.

Obs. #	Date	Transect #	On Transect	Plane Side	Adult Muskox	Calf Muskox	Adult Caribou	Calf Caribou	Moose	Wolves	Foxes
16	Mar. 11	8	Y	R	4						
17	Mar. 11	17	Y	R					1		
18	Mar. 11	16	Y	R					1		
19	Mar. 11	16	Y	R	32	3					
20	Mar. 11	15	Y	R					1		
21	Mar. 11	14	N	R	4						
22	Mar. 12	6'''	N	R	5						
23	Mar. 12	13	Y	L	4	1					
24	Mar. 12	12	Y	L	2						
25	Mar. 12	11	N	R	4						
26	Mar. 12	11	N	R	1						
27	Mar. 12	11	Y	R	8	1					
28	Mar. 12	11	N	R	4	1					
29	Mar. 12	11	N	L	16	2					
30	Mar. 12	11	Y	R	15	3					
31	Mar. 12	11	Y	R							1

APPENDIX 2 cont.

Obs. #	Date	Transect #	On Transect	Plane Side	Adult Muskox	Calf Muskox	Adult Caribou	Calf Caribou	Moose	Wolves	Foxes
32	Mar. 12	11	N	R	13	2					
33	Mar. 18	1	N	L	10	2					
34	Mar. 18	1	Y	R			4				
35	Mar. 18	1	Y	R						1	
36	Mar. 18	3'	Y	R							1
37	Mar. 18	3'	Y	R							1
38	Mar. 18	4'	N	R	1						
39	Mar. 18	4'	N	L	17	3					
40	Mar. 18	5'	N	R	3						
41	Mar. 18	5'	Y	L	17						
42	Mar. 18	5'	N	L	5						
43	Mar. 18	5'	N	R	13						
44	Mar. 18	6'	Y	R	1						
45	Mar. 18	6'	Y	R	13	3					
46	Mar. 18	6'	Y	L	4						
47	Mar. 18	6'	Y	R	14	3					

APPENDIX 2 cont.

Obs. #	Date	Transect #	On Transect	Plane Side	Adult Muskox	Calf Muskox	Adult Caribou	Calf Caribou	Moose	Wolves	Foxes
48	Mar. 18	6'	N	R	2						
49	Mar. 18	9	Y	R							1
50	Mar. 18	9	N	R	2						
51	Mar. 18	10	N	L	6						
52	Mar. 18	10	Y	R							1
53	Mar. 18	10	Y	R							1
54	Mar. 19	22'	N	R						12	
55	Mar. 19	18'	Y	L			4				
56	Mar. 19	17'	N	L						2	
57	Mar. 19	17'	Y	R			2				
58	Mar. 19	17'	Y	L			1	1			
59	Mar. 19	16'	Y	R			13	3			
60	Mar. 19	15'	Y	L			60				
61	Mar. 19	14'	N	R	6						
62	Mar. 19	14'	Y	R							1
63	Mar. 19	13'	Y	L	42	3					

APPENDIX 2 cont.

Obs. #	Date	Transect #	On Transect	Plane Side	Adult Muskox	Calf Muskox	Adult Caribou	Calf Caribou	Moose	Wolves	Foxes
64	Mar. 19	13'	Y	R	4						
65	Mar. 19	13'	Y	R	11	4					
66	Mar. 19	13'	N	L	13						
67	Mar. 19	10	Y	R	27	5					

APPENDIX 3

The number of muskoxen seen on transect during the survey.

Transect #	Area (km^2)	Adult Muskox	Calf Muskox	Total Muskox
1	38.25	0	0	0
2	63.00	0	0	0
3	114.25	0	0	0
4	139.63	0	0	0
5	146.75	17	0	17
6	156.38	32	6	38
7	154.38	2	0	2
8	226.25	0	2	18
9	227.25	16	0	0
10	194.50	0	5	32
11	201.00	27	4	27
12	200.50	23	0	2
13	204.25	2	8	69
14	214.50	61	0	0
15	152.50	0	0	0
16	157.50	0	3	35
17	162.00	32	0	0
18	166.75	0	0	0
19	172.00	0	5	41
20	176.25	36	0	3
21	176.25	3	0	1
22	176.50	1	0	1
TOTAL	**3620.64**	**253**	**33**	**286**